A Look at Plastic Card Lamination

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Lamination of plastic cards has been one of the fundamental process steps in manufacturing for many years. The process of laminating what is termed "conventional" plastic cards is well known and more of a science than an art today. The advent of so called "Smart"—or RFID Cards—ratchet up the complexity of manufacturing and creates new inflection points to be considered.

Lamination of plastic cards includes heat, pressure and time as machine variables, but there are material variables; and now new card technologies impose other considerations.

In all manufacturing operations, the most important criteria is to ensure that each step in the process is in statistical process control. Predictable quality and high yields require processes that are in control.

So-called contactless cards, with electronic components embedded within the card, must be impervious to outside influences such as heat, cold, the possibility of humidity and other mechanical influences. As a result, manufacturing contactless cards, which include an inner antenna and a semiconductor chip, requires the process engineer to observe several essential fundamentals.

Material: Predominantly, PVC is used for the complete configuration of the card. The heat resistance (Vicat value) can be of the average range. For some cards with thick wound antennas, which are inserted in the openings of the inner layer, even material of a higher Vicat value will be useful to ensure a better mechanical stability of the inner layer and avoid deformations of the antenna. The use of very soft materials can be a problem because this material softens already at low temperatures, and can cause deformations, particularly of the antenna. In addition, the complete thermal and mechanical stability of the card is reduced.

Materials such as PET, polycarbonate or others are possible for inner layers with an antenna and chip. However, as "face material," only PVC has been well proven so far. PET is too brittle and with polycarbonate, a high temperature is required for the embedding and lamination, which is not desirable.

Antenna and chip:

Principally, four versions of antennas are now possible:

- Wound wire antenna
- Embedded wire antenna
- Etched antenna
- Printed antennas

Wound wire antenna

For the individual configuration of a contactless card, wound wire antennas with a chip are used. Depending on the required performance, antennas can be made of thin copper wires with many windings with the thicknesses of the windings being approximately 300 up to 600 mü (0.3 to 0.6 mm).

Antennas with a chip are bonded with the inner layer foil by the customer (from the manufacturer of the cards). Thickness of the antenna ranges from approx. 300 to 400 mü (0.3 to 0.4 mm).

In the case of strong antennas of more than 400 mü, it is useful to have openings in the inner layer and to embed the antenna with the chip in this opening. The thickness of the inner layer should be slightly less than the thickness of the antenna so that the antenna can partially be pressed into the face material.

Embedded wire antenna

In the case of embedded wire antennas, the same are directly wound onto the inner layer material so that the card manufacturer has already fabricated materials.

Etched antenna

In the case of etched antennas, the structure of a copper foil on the foil is removed by etching. The chip is applied in a different process step. Such foils with etched antennas can be procured from manufacturers in the electronic trade e.g. printed circuit board manufacturers.

Process

Since various configurations of contactless cards exist with respect to the plastic material, number of plastic foils and different antennas, the

laminating process recipe must be determined for each configuration individually.

Important Points

1) To prevent the structure and geometry of the antenna and chip from becoming damaged as a result of the process, it is necessary to soften the material which supports the antenna and the chip as well as the adjacent foils for the further embedding of the antenna and the chip prior to lamination (embedding process).

While laminating using a hydraulic laminating line, the press is only closed so that the heating platens can transfer the heat into the laminates, and only a small contact pressure is applied onto the laminates. This prevents damage to the components and warpage of the antenna.

2) When a thermoplastic (soft) state of the foils has been reached, the laminating pressure for embedding the antenna and the chip, as well as for bonding the additional foils, is slowly increased and applied. This pressure is maintained constant until the end of the cycle.

3) The laminates remain under temperature and pressure for some time so as to complete the mechanical embedding of the antenna. This cycle is generally longer than that used in conventional plastic card lamination.

4) During the cooling cycle it is possible to increase the lamination pressure as needed. This ensures a good mechanical bond and promotes a better surface condition of the laminate.

5) One optional process used to avoid air entrapment between the antenna, chip and the openings on or in the inner layer is to laminate in a vacuum. Vacuum evacuation is made before the first process step within the press and is maintained until the end of the process. This process is not universally used.

Depending on the structure of the antenna and of the chip, and the differences in thickness, it is useful to manufacture a pre-laminate, which consists of an inner layer with an antenna and chip, and the top layers. This allows a better compensation of the differences and thus a better surface for the later lamination of printed foil and overlay foil.

Operation:

Assembly of a "book" that will be laminated is similar to that of conventional plastic cards. Eight to ten card sheets (depending on the

type of material and configuration of the card) are separated by a press sheet made of steel the size of the laminate. This package is then fed into the press openings. The lay up station can be either horizontal or vertical depending on the card type.

Laminating Machine:

Conventional hydraulic machines, similar to those in production today, are used in laminating contactless cards. Often, an optional method of counterbalancing the weight of the books and the platens is used to exert minimum force on the package until the material has softened, as noted above.

A number of machine characteristics are important to consider when laminating high quality and complex contactless cards:

• Either Twin Stack or Single Stack lamination systems can be used in laminating contactless cards; however, depending upon the type of card and construction, one system may have advantages over the other. Production requirements or type of cards often dictate the hydraulic laminating system used.

• The laminating press should be statically stable and the platens plane parallel with each other to assure even pressure throughout the book.

• Heating of the platens should be uniform across the platens to within ±1°C. Thermal oil is a good heating medium for this application as it provides uniform heat and a heating cycle that provides a recipe controlled heat ramp, and also a controlled cooling ramp. All components of the process application recipe are measurable for good statistical process control.

• Optional vacuum lamination can be used for special applications